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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:)
STEVENSON)
Serial No. 09/591,886)
Filing Date: June 9, 2000)
For: IMPROVEMENTS IN OR RELATING)
TO IMAGE SENSOR PACKAGING)
_____)

TRANSMITTAL OF CERTIFIED PRIORITY DOCUMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Transmitted herewith is a certified copy of the
priority United Kingdom Application No. 9913516.2.

Respectfully submitted,

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INVESTOR IN PEOPLE




The Patent Office
Concept House
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Newport
South Wales
NP10 8QQ

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Dated 19 May 2000



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The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference

P23943/ALO/JCO

2. Patent application number

(The Patent Office will fill in this part)

9913516.2

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Vision Group plc
Aviaton-House
31 Pinkhill
Edinburgh
EH12 7BF

Patents ADP number (if you know it)

07551773001

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention

"Improvements in or Relating to
Image Sensor Packaging"

5. Name of your agent (if you have one)

Murgitroyd & Company

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

373 Scotland Street
GLASGOW
G5 8QA

Patents ADP number (if you know it)

1198013 ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
(if you know it)

Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

YES

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

c) any named applicant is a corporate body.

See note (d))

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description

7

Claim(s)

2

Abstract

-

Drawing(s)

2 + 2

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Priority documents

-

Translations of priority documents

-

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

-

Request for preliminary examination and search (Patents Form 9/77)

-

Request for substantive examination (Patents Form 10/77)

-

Any other documents (please specify)

-

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date

Murgitroyd & Company

10 June 1999

12. Name and daytime telephone number of person to contact in the United Kingdom

John Cooper

0141 307 8400

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1 "Improvements in or relating to Image Sensor Packaging"

2

3 The present invention relates to the packaging of
4 integrated circuits for use as image sensors ("image
5 sensor chips").

6

7 Most types of integrated circuits ("chips") require
8 "packaging" to encapsulate the sensitive chips and
9 provide mechanical protection during shipping, assembly
10 and subsequent use. Optical chips such as image
11 sensors are unusual in that it is necessary for their
12 packaging to include a transparent window to admit or
13 release light. In the case of image sensors, the
14 window allows light to impinge upon the optical sensor
15 array which forms part of the chip. The transparent
16 window, or lid, is commonly formed from glass.

17

18 Optical devices of this type are also unusually
19 difficult to manufacture because of stringent
20 requirements for cleanliness. Any foreign material
21 impinging on onto the surface of the sensor array can
22 cause image degradation leading to rejection of the
23 device and hence to higher component cost due to
24 reduced manufacturing yield.

25

1 Conventionally, image sensor packages are formed by
2 mounting a plurality of sensor chips in a rectangular
3 array on a substrate tile (typically of ceramic
4 material). After wire bonding, a lattice of "dam"
5 walls is written in liquid epoxy between the adjacent
6 chips, so that each chip is surrounded on all four
7 sides by a wall of epoxy material. A glass sheet is
8 then placed on the top surface, adhering to the tops of
9 the dam walls and encapsulating each chip in isolation
10 from the surrounding chips. The whole assembly is then
11 baked to harden the epoxy walls and then cut along the
12 lines of the walls between adjacent sensors to produce
13 a plurality of individual, encapsulated sensor devices.

14
15 This technique is very cost effective, but has a
16 significant disadvantage. Resin can bleed out of the
17 dam wall material when in the liquid state, running by
18 capillary action onto the chip surface and, in some
19 instances, onto the critical image sensing array area,
20 causing unacceptable image blemishes. Accordingly, the
21 manufacturing yield is reduced and the unit cost of the
22 sensor devices is increased.

23
24 This problem applies to both monochrome and colour
25 sensors, the latter having a thin layer (typically less
26 than 2 microns) of colour filter material (the
27 "mosaic") covering the sensitive array area.

28
29 It is an object of the present invention to provide
30 improved methods for packaging image sensors, and
31 improved image sensors formed thereby, in which the
32 above mentioned problem is obviated or mitigated.

33
34 In accordance with a first aspect of the present
35 invention, there is provided a method of manufacturing
36 an image sensor device of the type comprising an image

1 sensor chip, including an image sensor array formed on
2 a top surface thereof, mounted on a substrate and
3 encapsulated by means of a dam wall formed on the
4 substrate and surrounding the periphery of the sensor
5 chip and having a transparent lid member affixed to the
6 upper edges of said dam wall, wherein the method
7 includes forming a barrier on the surface of said
8 sensor chip and extending along at least a substantial
9 part of at least one side of said sensor array between
10 the sensor array and the dam wall.

11
12 Preferably, said barrier is formed with a height of at
13 least three microns.

14
15 Preferably, said barrier surrounds said sensor array.

16
17 Preferably, said barrier is formed during fabrication
18 of the sensor chip.

19
20 Preferably, where said sensor chip is a colour image
21 sensor including a mosaic of colour filter material
22 overlying said sensor array, said barrier is formed
23 from said colour filter material simultaneously with
24 the formation of said mosaic. Most preferably, said
25 barrier is formed from a plurality of layers
26 corresponding to a plurality of colours of filter
27 material forming said mosaic.

28
29 In accordance with a second aspect of the invention,
30 there is provided an image sensor chip, including an
31 image sensor array formed on a top surface thereof,
32 including a barrier formed on the surface of said
33 sensor chip and extending along at least a substantial
34 part of at least one side of said sensor array.

35
36 Preferably, said barrier is formed with a height of at

1 least three microns.

2

3 Preferably, said barrier surrounds said sensor array.

4

5 Preferably, where said sensor chip is a colour image
6 sensor including a mosaic of colour filter material
7 overlying said sensor array, said barrier is formed
8 from said colour filter material simultaneously with
9 the formation of said mosaic. Most preferably, said
10 barrier is formed from a plurality of layers
11 corresponding to a plurality of colours of filter
12 material forming said mosaic.

13

14 In accordance with a third aspect of the present
15 invention, there is provided an image sensor device of
16 the type comprising an image sensor chip, including an
17 image sensor array formed on a top surface thereof,
18 mounted on a substrate and encapsulated by means of a
19 dam wall formed on the substrate and surrounding the
20 periphery of the sensor chip and having a transparent
21 lid member affixed to the upper edges of said dam wall,
22 wherein the sensor chip includes a barrier formed on
23 the surface thereof and extending along at least a
24 substantial part of at least one side of said sensor
25 array between the sensor array and the dam wall.

26

27 Preferably, said barrier is formed with a height of at
28 least three microns.

29

30 Preferably, said barrier surrounds said sensor array.

31

32 Preferably, where said sensor chip is a colour image
33 sensor including a mosaic of colour filter material
34 overlying said sensor array, said barrier is formed
35 from said colour filter material simultaneously with
36 the formation of said mosaic. Most preferably, said

1 barrier is formed from a plurality of layers
2 corresponding to a plurality of colours of filter
3 material forming said mosaic.

4

5 Embodiments of the invention will now be described, by
6 way of example only, with reference to the accompanying
7 drawings, in which:

8

9 Fig. 1 is a plan view of a substrate having a plurality
10 of image sensor chips mounted thereon; and

11

12 Fig. 2 is a sectional side view of an embodiment of an
13 image sensor device formed in accordance with the
14 present invention.

15

16 Referring now to the drawings, Fig. 1 shows a substrate
17 10, typically of ceramic material, having an array of
18 individual image sensor chips 12 mounted on an upper
19 surface thereof. Each of the chips 12 includes an
20 image sensor array (not shown) on its top surface.

21

22 In accordance with a conventional manufacturing
23 process, after wire bonding, the individual chips 12
24 are encapsulated in situ on the substrate by writing
25 dam walls (14, Fig. 2) of liquid epoxy material along
26 the gaps between the chips 12 and around the periphery
27 of the array of chips 12. As seen in Fig. 2, the dam
28 walls 14 are formed on the surface of the substrate 10
29 and overlap the edges of the chips 12. A glass sheet
30 (16, Fig. 2) is then laid on top of the dam walls 14
31 and bonded to their upper edges, so that each chip 12
32 is encapsulated between the substrate 10, dam walls 14
33 and glass sheet 16. The whole assembly is then baked
34 to harden the dam walls 14 and diced by sawing along
35 the dam walls 14 between the chips 12 and around the
36 periphery of the array of chips 12 to produce a

1 plurality of individual, packaged devices.

2

3 Fig. 2 shows a cross sectional view of a single image
4 sensor device formed in this manner.

5

6 As noted above, a problem which arises with this
7 manufacturing technique is that resin can bleed out of
8 the dam walls 14 while in the liquid state, running by
9 capillary action over the chip surface and thereby onto
10 the image sensing area, causing unacceptable image
11 blemishes. Such resin bleed is indicated at 18 in Fig.
12 2.

13

14 In accordance with the present invention, this problem
15 is obviated or mitigated by forming a barrier 20 on the
16 chip surface between the dam walls 14 and the image
17 sensing array of the chip 12. Such a barrier 20
18 impedes the progress of the liquid resin and prevents
19 it impinging onto the sensor array 22. It has been
20 found that a barrier at least about 3 microns in height
21 is effective in arresting the resin bleed 18. The
22 barrier 20 may extend around the entire periphery of
23 the sensor array 22. However, depending on the size
24 and location of the sensor array 22 on the chip surface
25 in relation to the dam walls 14, it may be sufficient
26 to form the barrier 20 along at least a substantial
27 part of at least one edge of the sensor array 22.

28

29 The barrier 20 may be formed during fabrication of the
30 image sensor chips 12 as an integral part of the
31 manufacturing process, being deposited by means of any
32 conventional chip fabrication process such as
33 photolithography. The barrier 20 may be formed from
34 materials which are conventionally used in the
35 fabrication of the image sensor circuitry on a
36 semiconductor wafer, so that the invention may be

1 implemented at, effectively, zero cost.

2

3 In the case of a colour image sensor, it is
4 particularly preferred that the barrier be built from
5 the materials used to form the conventional three-
6 colour filter mosaic on top of the image sensing
7 circuit. The colour filter material is typically of
8 the order of one micron in thickness, so that stacking
9 all three colours of material on top of one another in
10 the barrier area provides the required barrier height
11 of about three microns, without adding to existing
12 manufacturing costs. This barrier construction is
13 illustrated in detail 24 of Fig. 2.

14

15 The invention thus provides improved image sensor
16 chips, packaged image sensor devices and methods of
17 manufacturing the same.

18

19 Modifications and improvements may be incorporated
20 without departing from the scope of the invention.

21

22

23

24

1/2

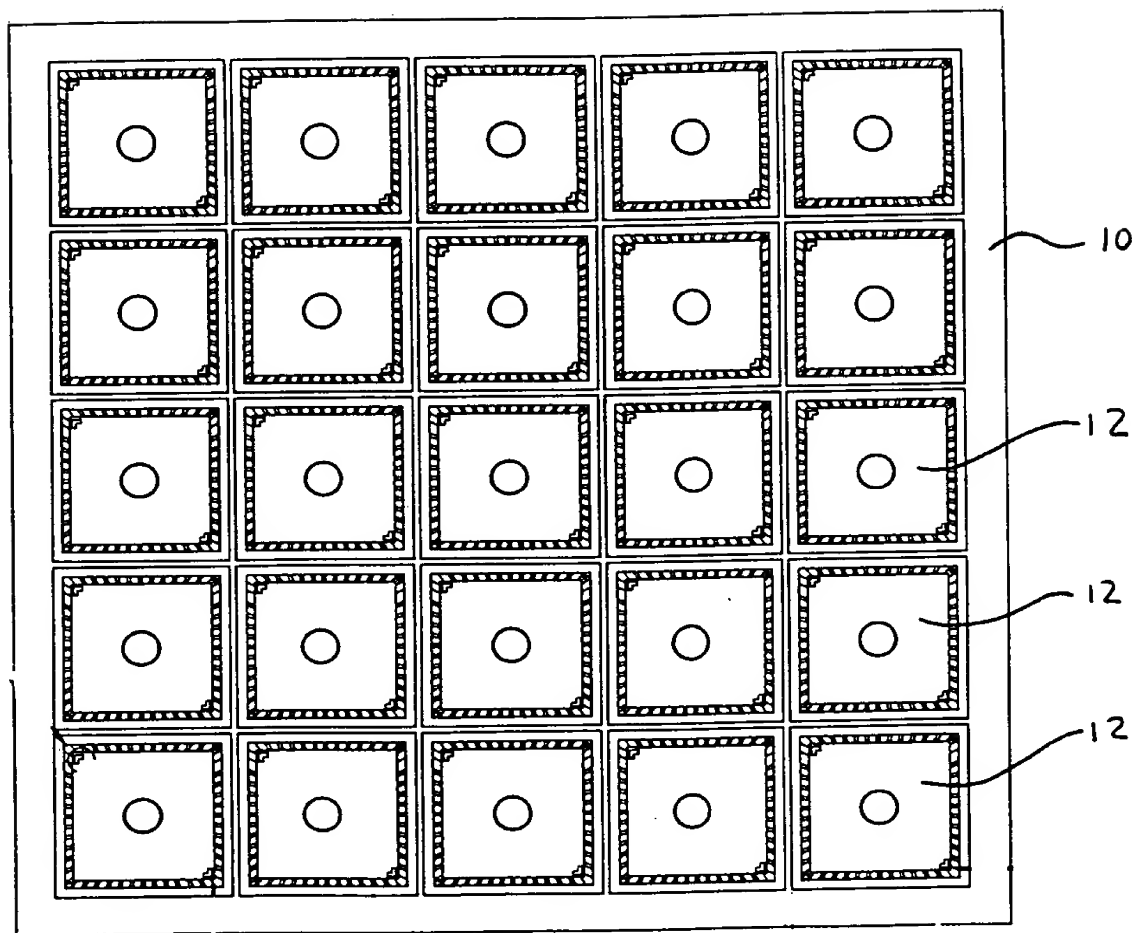


FIG. 1

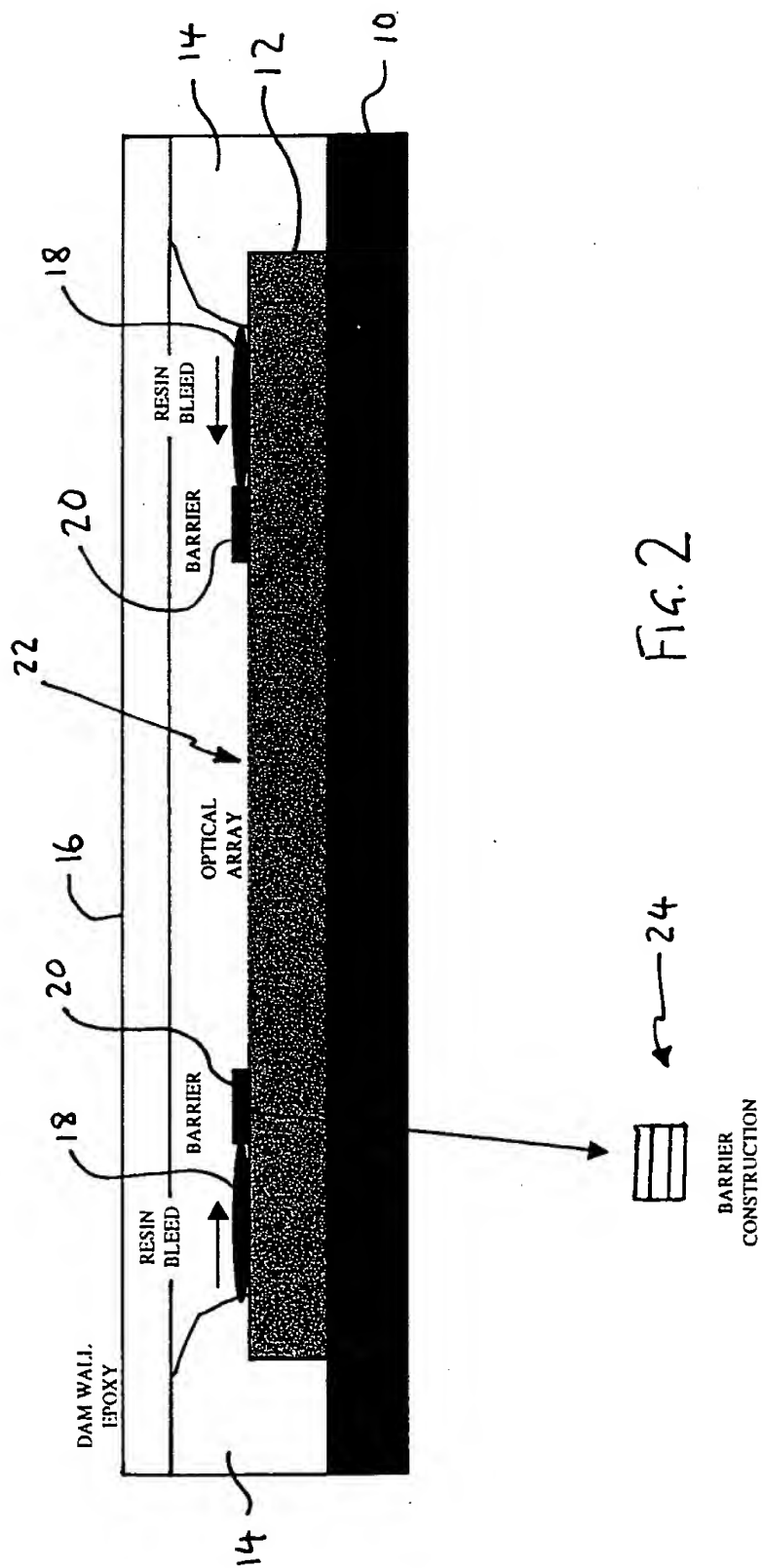


FIG. 2